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ABSTRACT

The Pre-College Program is a unique design in inductive learning for the high school student from a family of low or modest income. In this program the student is not "taught," he is provoked to learn. It aims at encouraging him to integrate and profitably use his present knowledge, as he continues to increase it in a free and informal academic atmosphere. Each Pre-College Center offers English and mathematics classes, special-interest workshops, cultural and recreational activities to about 200 high school seniors and juniors, who remain in the Program for one full year. On Saturday mornings during the academic year and daily during the summer session, six selected teachers in each discipline conduct classes of not more than 20 students, using materials that are developed to broaden the contexts of English and mathematics instruction. This document presents an introduction to the Pre-College Program, a brief history of the program, and examples of the English and mathematics program. A sampling of student activities and sample data on pre-college students is also included. (Author/PG)

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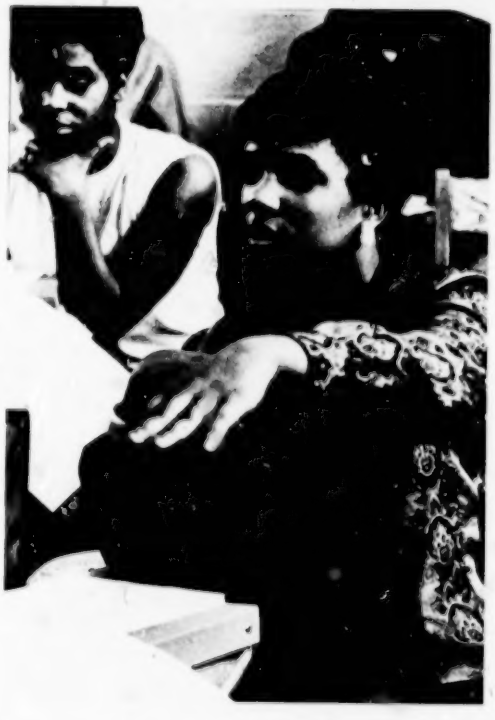
To Gladly Learn



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An Account of the Program for Pre-College Centers

Dillard University *Howard University* *Texas Southern University*

Fisk University *Morehouse College* *Webster College*

Educational Services Incorporated

This publication of TO GLADLY LEARN *has been made possible by a grant from the Esso Education Foundation*

Preface

Herman Melville stated that to produce a mighty book, you must choose a mighty theme. If Melville was correct, then this slim pamphlet has fulfilled that requirement, for no mightier theme exists in our time than the one we have attempted to embody in these pages: the development of procedures for sympathetically unmasking the high qualities latent in young people, qualities which are often bypassed in the standard educational process.

The Pre-College Center Program has been in operation now for a year and I, for one, am greatly heartened by the entrancing sense of cohesion and solid harvest of accomplishments that have resulted. This pamphlet is a distillation of those things which we have found most effective in carrying out our tasks. In another sense, it is profoundly revelatory of the hard work and intense but healthy interaction which we have achieved in so short a time.

The traditional system of education too often reveals itself as the primé supporter of the Puritan myth that mirthless work is a virtue and enjoyment is consonant with guilt. In the Pre-College Program I believe that we are demonstrating not only that effective learning is the natural product of engrossing, relevant, and enjoyable study, but also that young people can seize upon the most abstruse themes with relish and understanding if the materials are presented with taste and in an atmosphere of concern.

HERMAN BRANSON
Director
Program for Pre-College Centers

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"It is my belief that this program will be of invaluable aid to the college student. First, because it teaches in an expository rather than a depository manner. The math helps one to think rather than to memorize everything, and the English teaches one to express himself. Actually what you know won't help if you cannot express it."
Pre-College Student
Summer, 1965

Several pictures courtesy of New Day – weekly supplement to Forward Times, Houston, Texas.

The Initial Step

Alarm over the drop-out rate at Negro colleges leads to the establishment of the Program for Pre-College Centers.

Toward the end of January 1963, a committee of presidents of predominantly Negro colleges came to Washington, D. C., to discuss with Dr. Jerome B. Wiesner, at that time Science Advisor to President Kennedy, the educational crisis that threatened such colleges. In April, the problem was brought before the President's Science Advisory Committee Panel on Educational Research and Development at the first of a series of meetings. Research advisors and other educators were called in to assist the Panel in investigating ways of radically reducing the drop-out rate and improving the conditions of these colleges. The result of this investigation was a report entitled "Program for Negro Colleges," prepared during the summer of 1963 by Dr. Samuel M. Nabrit, President of Texas Southern University, Mr. Stephen White, Assistant to the President of Educational Services Incorporated, and Professor Jerrold R. Zacharias of the Massachusetts Institute of Technology and Chairman of the Panel on Educational Research and Development. The Carnegie Corporation of New York expressed an interest in the problem facing the Negro colleges and approved a grant to Educational Services Incorporated for establishing a program to explore and possibly implement some of the recommendations in the report. The following section from this document became the basis for the development of the Program for Pre-College Centers:

Neither in his school nor in his home has the Negro student been encouraged to acquire the habits of crisp, economical speech or attentive listening. He is not the master of his own language, and it does not serve him efficiently as a tool.

In a nominal sense, he has learned to read, but he is likely to read obediently, in response to a directive. He is the servant of books, rather than their master; he does not know how to seek, upon his own initiative, for knowledge or for delight in printed matter.

Somewhere during his schooling the relationship has been lost that should link formal education with his own human development as an individual within society. History, literature and the arts are mastered, if they are mastered at all, in relation to examinations and promotion; their true significance to the whole man is lost. They cease, in short, to be humanistic studies and become items in a curriculum that exists only for its own sake.

Similarly, the mathematics that the student may have mastered is barren of its true import. That it has relevance to the real world, and utility in dealing with the real world, has never been made clear. The student has learned to compute, and perhaps to state formal proofs, but these achievements, like his achievement in the Humanities, constitute a closed system referring in every instance to nothing but themselves.

His academic knowledge, for the most part, rests on the authority of his teacher or his teacher's textbook. In the discipline of school and college, he has little notion of how one sets out to elicit information which has not first been codified by someone else. Necessarily, he is quite capable of learning by means of experiment and mother-wit how one manipulates his social and domestic environment, but his approach to formal education is artificial and unreal.

These deficiencies must be remedied before the freshman can begin to profit from a college education.

It is proposed, therefore, that a complete body of learning aids be prepared, at the level of the Negro graduate from secondary school, dealing with Communications, the Humanities, Mathematics and Inquiry.

The first of these would deal with speech, listening, reading, and writing. It would be intended to relieve the Negro college of the necessity for remedial work in these subjects—and would enable the college to presume that its freshmen would be able to carry the basic tools of communication into their first year of instruction.

In the Humanities, the emphasis of the new materials would be upon the relationship between hu-

manistic studies and the individual. The material would be directed toward a comprehension of the knowledge that the student has already accumulated, rather than upon the acquisition of new "facts."

Similarly, in mathematics, the attempt would be made to make the transition between mathematics-by-rote and mathematics as a tool. Finally, a laboratory course would concentrate upon the methods and purposes of laboratory inquiry as a general means of procedure, rather than as an element in building a coherent structure in one science or another.

The manner in which these materials are to be used would be allowed to remain as a matter that must be determined by experience. It might be advisable to add a fifth year of secondary school for students admitted to college; to require one or more intensive summer courses; or to remove the college-bound student from secondary school in February of his senior year and transfer him to special schools run by the Negro colleges themselves, for a concentrated effort during the nine months before matriculation. The materials should be flexible enough to bend to all these uses, and perhaps to others.

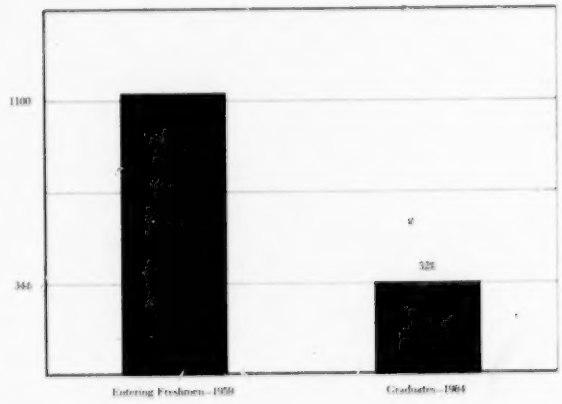
During the process of preparing these materials, the best available teachers from Negro colleges and secondary schools would be intimately associated with the work, and would provide part of a cadre of teachers intimately familiar with the materials. The first employment of the materials would be in a series of intensive summer institutes, in which a substantially larger number of teachers and professors would be trained in their use.

It might be added here that the existence of such materials would be of immediate benefit to a far larger group than merely the Negro students. Remedial materials of this sort are in general demand throughout the United States—where in general the level of skills in Communications, the Humanities, Mathematics and Laboratory are inadequate for the requirements of higher education.

Preparation of these materials, it should be stressed, will require a major effort. It will be necessary for scholars and teachers, in large numbers, to give their full attention to this program over a period of three or more years, and for an even larger number to contribute their summer time.

In compliance with the recommendations of this report, the Pre-College Group of Educational Services Incorporated designed the Program for the Negro student (five of the six colleges where Centers are located are predominantly Negro institutions); other studies, however, revealed that the description of the student in this report was applicable to all youth from rural and urban slum areas. Grants from the Office of Economic Opportunity have made it possible to expand the Program to include all interested students from such low-income families.

A SAMPLE CLASS AT A REPRESENTATIVE NEGRO COLLEGE



The drop-out rate (nearly 70%) at such colleges led to an investigation of ways to alleviate the problem, as reported in "Program for Negro Colleges."

A Brief History

1963

April The Panel on Educational Research and Development of the President's Science Advisory Committee began investigating means of combatting the educational crisis faced by Negro colleges.

Summer The plight of Negro colleges and recommendations for improving such schools were presented in the report, "Program for Negro Colleges."

October An Ad Hoc Committee* on Education in Predominantly Negro Colleges was appointed to assume temporarily the responsibility for exploring programs for improving Negro colleges. Educational Services Incorporated offered the Committee its assistance in setting up a pilot program that would implement the recommendations of the report.

1964

March The Carnegie Corporation of New York granted funds to Educational Services Incorporated, for use in initiating a five-year developmental college-preparatory program for Negro students.

Summer A writing conference was held at Pine Manor Junior College in Wellesley (June 22-August 14), at which the preparation of materials for the English and mathematics curricula was begun. An office for the Pre-College Center Program was established in Watertown. The organization of Centers to be established in southern cities was begun.

1965

March Six Pre-College Centers opened at Morehouse College, Atlanta; Fisk University, Nashville; Texas Southern University, Houston; Howard University, Washington, D. C.; Dillard University, New Orleans; and Webster College, St. Louis. Some 1200 high school seniors met weekly during the school year for English and mathematics classes at the Centers. A grant from the Carnegie Corporation of New York supported the operation of the Centers from March to June, 1965.

April A joint meeting of the Center Directors, representatives from the Office of Economic Opportunity, and the Central Office of the Pre-College Program (now, the Curriculum Resources Group) was held at ESI to discuss the future plans of the Centers. It was decided that all students from families within a specified low-income range would be eligible to enroll in the Pre-College Program in their communities. It was also decided that the summer sessions at the Centers would be extended to residential programs, offering morning classes and afternoon workshops of additional educational and cultural activities. The Office of Economic Opportunity accepted the responsibility for financing the Centers as a demonstration project for "Upward Bound" programs.

Summer The six Pre-College Centers received grants from the Office of Economic Opportunity to operate eight-week residential sessions for approximately 900 students. During this time, June 14-August 6, a second writing conference was held at Wheelock College in Boston, Massachusetts; participants at the conference visited the six Centers and continued developing instructional materials in English and mathematics. The Neighborhood Youth Corps of the Department of Labor provided jobs for the students from the close of the eight-week session to the opening of the college term.

October The six Centers re-opened with grants from the Office of Economic Opportunity. Saturday sessions resumed for the new academic year.

1966

May Centers concluded Saturday Sessions for the academic year.

June The six Centers resumed the residential Summer Sessions. Each Center expanded to include 100-200 juniors who will remain in the Program for one year.

Summer A third writing conference for preparation of materials in English and mathematics was held at Pine Manor Junior College in Chestnut Hill, Massachusetts, for eight weeks (June 20-August 13).

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*The original members of the Ad Hoc Committee are listed on page 40.

"In addition to whatever growing experiences the students are having, we who are the teachers are also growing a great deal. We are learning a lot about the thinking which the kids are doing and their ability, depth perception. . . . I think all of us are excited about what is happening both to us and what appears to be happening to the kids."

"The teachers don't try to make you learn; they just make their classes so interesting until the students want to learn as much as they can."

"In my opinion and not meaning to flatter the Program, I think it's great."

"I came to find the answer to college success. Instead I found keys: an open mind, the willingness to study and work hard, the right attitude and the determination to succeed. But the answer to college success, I know now, lies within me."

"Knowledge is pulled from the student instead of being poured into him."

An Introduction to the Pre-College Program

Nature of the Program The Pre-College Program is a unique design in inductive learning for the high school student from a family of low or modest income. It is a program in which the student is not "taught"; he is provoked to learn. It aims at encouraging him to integrate and profitably use his present knowledge, as he continues to increase it in a free and informal academic atmosphere. It endeavors to transform him from one who responds passively to learning into one who questions, analyzes, initiates, creates. It seeks to make him a full participant in all his classwork, to allow him—rather than his teachers—to become responsible for his education. It attempts to heighten both his self-image and his career chances. All of these objectives the Program is designed to accomplish through classroom experiences which focus on the student rather than on the subject matter, and through social interactions which confront him with a variety of intellectual and cultural challenges.

The Program is supported by grants from the Carnegie Corporation of New York and the Office of Economic Opportunity. It is presently in operation at six Pre-College Centers, located on the campuses of Howard University in Washington, Morehouse College in Atlanta, Dillard University in New Orleans, Texas Southern University in Houston, Webster College in St. Louis, and Fisk University in Nashville.

Mode of Operation Each Pre-College Center offers English and mathematics classes, special-interest workshops, cultural and recreational activities to about 200 high school seniors and juniors, who remain in the Program one full year. On Saturday mornings during the academic year and daily during the summer session, six selected teachers in each discipline conduct classes of not more than 20 students, using materials* that are developed to broaden the contexts of English and mathematics instruction, and to promote lively discourse among students and teacher. After the morning classes, during both sessions, the students meet informally with undergraduate and graduate students, drawn from local colleges and universities, who serve as program assistants. Working together, the program assistants and pre-college students organize special activities that complement the morning's academic studies, and, under the guidance of the Center counselor, investigate the practical problems of choosing a career and an appropriate college in which to prepare for it.

During the intensive eight-week summer session, the students are in residence on the campuses where the Centers are located. This sustained contact with the students allows the Centers to increase the variety of afternoon workshops, special classes, field trips, and cultural events that each offers. In addition, teachers, program assistants, and students plan jointly other afternoon and evening activities that take full advantage of the special skills of individual staff members and the cultural resources of the community. Thus, the diversity of the afternoon and evening programs is an important facet in the students' development.

People Associated with the Program The Curriculum Resources Group, at Educational Services Incorporated in Newton, Massachusetts, has assembled a confederation of teachers, scholars, and writers to work on the development of new materials in mathematics and English. Professors of physics, mathematics, English, and humanities, from Massachusetts Institute of Technology, University of Rochester, Morgan State College, Simmons College, Notre Dame University, and Howard University; high school English and mathematics teachers from Massachusetts, New York, New Jersey, and Washington, D. C.; industrial research physicists; poets and writers, meet with the resident staff of the Curriculum Resources Group to prepare the course materials used in the Program. Teachers from this group visit the Centers, hold demonstration classes, and consult with Center teachers on the evaluation of existing materials and the creation of new ones. The Curriculum Resources Group also coordinates the operations of the Centers; assists the Center staffs in administering the Program; edits, distributes, and revises the materials for instruction; and conducts teacher-training and orientation meetings.

*These materials are described in detail in "The Mathematics Program" and "The English Program," on pages 14 and 20 respectively.

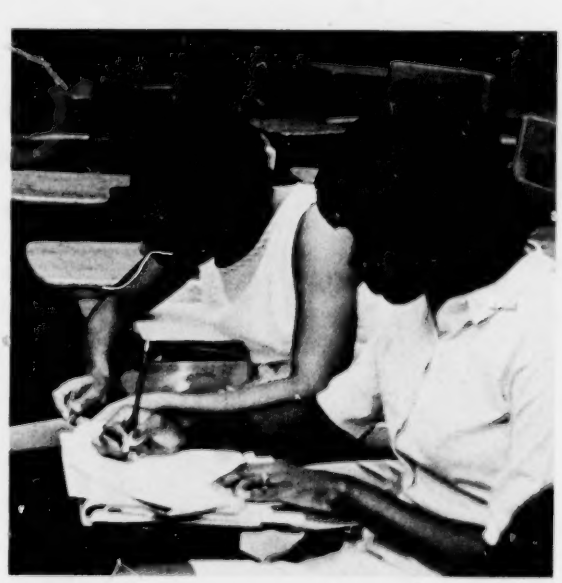
The Research and Evaluation Group, also at Educational Services Incorporated, looks objectively at the operation and impact of the Program. Since the Program is innovative, and since changes in the students vary greatly from immediate to long-range, from manifest to subtle, the Research and Evaluation Group utilizes varied research techniques for collecting and analyzing organizational and individual data. In this they seek to achieve a better understanding and assessment of the operation and effectiveness of the pre-college experience in fostering changes in academic performance, attitudes, self-image, and career development.

At the Centers, the staffs have been gathered from regional schools and colleges. The directors and counselors recruit and select teachers and students, and help to insure efficient operation of the Program; the competent and creative teachers guide the students through new learning experiences, both inside and outside the classroom, and assist the Curriculum Resources Group in teacher-training and orientation of new personnel; and the program assistants serve as models, friends, confidants, and advisers in helping the students profit from the many facets of the Program.

Accomplishments of the Program The Pre-College Program is designed explicitly to instill in the student a confidence in his own potentialities, and a recognition of his own capacity and responsibility for choosing and shaping the quality of his life. The structure of learning that has been developed for the Program introduces the student to sympathetic teachers, stimulating and cooperative classroom atmosphere, and varied range of experiences that are conducive to such personal and intellectual growth.

The excitement of the teachers and students, their comments on rediscovering the pleasures of teaching and learning—these are indications that both teachers and students benefit from participating in the Program. Reports from observers at the Centers express enthusiasm about the insight and perception displayed by students in class discussions. These observers have been gratified to see students who are frequently labelled "deprived" or "remedial"—and, consequently, often suspected of being intellectually inadequate—engrossed in reading and discussing with increasing understanding the works of Camus, Thoreau, Darwin, and Hemingway; or absorbed in refining a "paper computing machine" they have invented, which will multiply and divide. It is, of course, too soon to know whether these benefits—the excitement in learning, the increased sense of self, the new insights and greater powers of perception—will endure. David Hawkins, an ESI consultant and former director of Elementary Science Study, has observed that on the journey toward comprehension, "all of us must cross the line between ignorance and insight many times before we truly understand."* By providing nourishment for that journey, by helping the students to cross that line again and again, we assure the permanent value of the Pre-College Program in the students' total development.

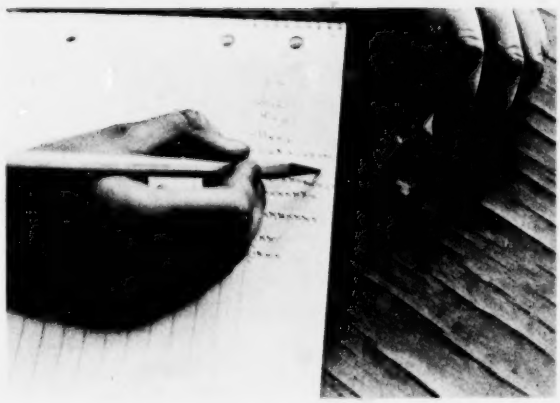
*From "Messing About in Science," *Science and Children*, Vol. 2, No. 5, February, 1965.



What goes on....

"While in these classes for the last month I have seen, excuse the expression, some of the dumbest people make reasonably intelligent statements."

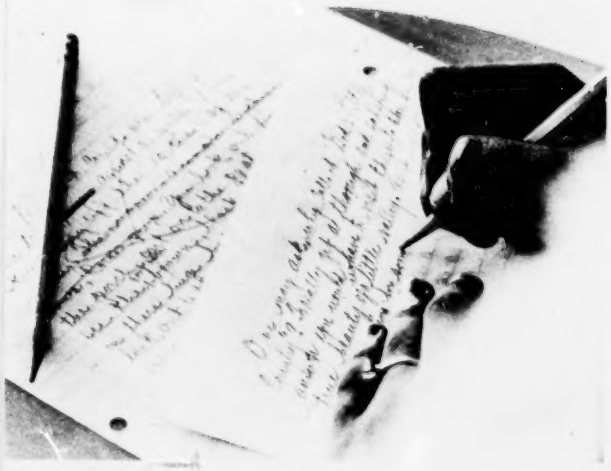
"He shows you other things that are related to mathematics and you don't really know it until he leads you back into math with numbers and you can see the same thing happening that happens in everyday life. He goes back and uses numbers and he doesn't actually come out and say that this is related but he goes through a series of examples and just about everyone begins to see the relation. . . . Everyone really sees it, though he doesn't really say a word about it."



"The class on a whole is very good. We are free to speak whenever we please without feeling small, regardless of whether we are right or wrong. Sometimes I become lost, but before I know it, it has been explained. I've caught up again."

...in Math and English

"I feel that my English class is unique in one respect. It breaks away from the dogma that the teacher is king, and it also shows that just because another person sees a situation from a different point of view, that doesn't mean that it's wrong. It also deviates from our public school system in that it gives all students a chance to show their talent, whereas in our public school system you must specialize in memorizing facts."



"And in English—it is not exactly English. It is . . . a discussion period. I like it because . . . it is altogether different. . . ."

"The English class I attended was very stimulating. I was shown new areas of interest—art, music, and literature. I became more aware of these things, so much so that I actually became involved with them. This course made me think and learn to argue a point. I've gained more confidence in my speech and in my ideas. This, above all, is the most important gain of the Program."

The Mathematics Program

The Pre-College mathematics class, free from the pressure to cover a prescribed curriculum, offers the student an opportunity to try activities and investigations that will lead him to ask questions, and help him to discover on his own the underlying relationships and fundamental concepts of various mathematical areas. The emphasis in the classroom, therefore, is on exploration, invention, and the hunch.

There is a style of teaching that is intimately connected with this approach to mathematical learning. It looks to the responses of the students for the direction and progress of the class. It is a style in which the teacher understands the general structure and logic of the subject, and is aware of many of the alternative pathways within this framework; but in which the students choose the actual course of the inquiry.

The interaction in a class of students with this style of teaching and the mathematics materials will produce many learning sequences. The development of one of these sequences by a class may be compared to a path taken through a network of crossing and recrossing lines. There are many starting points in this network; many intersections of the paths as one progresses through it. While the network never ends, there are places where one may pause and reflect before moving further, and each of these places can be reached by a great variety of routes. Although there is no one conclusion at which everyone must arrive, there is a sense of increased understanding at each of these resting places.

The task of the mathematics curriculum innovator, then, is multi-dimensional. He seeks out a particularly fruitful topic and organizes the written and physical materials which can facilitate its investigation. He provides the teacher with the necessary background information which will allow him to move confidently in the area, and which will strengthen his ability to recognize the relative usefulness of various student questions and suggestions. Finally, the innovator, using results obtained in trial teaching, indicates how the topic has proceeded in some classes.

The following classification of mathematics units is based on the mode of introducing the topic. In each category one unit is described in some detail.

1 Units Involving Physical Apparatus

Surface Area. Using wooden blocks, students determine the surface area of various combinations of cubes, working toward the formula for n cubes placed end to end. The unit proceeds to rectangular blocks, first uniform in size, then varying in length, and the students develop techniques for analyzing the area of different combinations of blocks.

Others:

Crazy Dice
Introduction to Computer Programming
Switches and Batteries
Geometry with Wax Paper
Polygons and Polyhedra
Nomographs
A Finite Geometry
Informal Geometry

2 Units Involving "Games"

The 1 to 20 Counting Game. This counting game can be easily analyzed by the students; however, variations of the rules can make the winning strategy increasingly complicated. The original game admits no tie and can always be won by the first player; yet it is possible to change the rules in such ways that the second player can win, or that a tie can result.

Others:

15 Puzzle
Art of Dueling (Some Old Math)
Probability and Game Strategy

3 Units Involving "Geometric Situations"

Map Coloring. Students begin by coloring geographical maps, gradually being prodded to abstract the problem; 2-colored maps are studied, and the 4-color conjecture is formed. Students then move from the plane to the sphere (showing that the problem is the same in both cases, with sheets of rubber to help), and to the regular solids. Finally, proofs of the 5-color theorem and Euler's Theorem are developed (the latter being applied to

the proof that there are at most five regular solids).

Others:

Pythagorean Theorem
Euclidean Algebra
Relativity

4 Units Involving "Numerical Situations"

Empirically Derived Functions. In this unit the idea of function is approached from several directions. At first, to give practice in coordinate representation, students play Coordinate Tic-Tac-Toe; they then experiment with the graphing of linear functions and establish the significance of the various constants. Another approach is through "Guessing Functions"—the students develop strategy for analyzing data and guessing the rule that produced it. This leads into an operational approach to graphs, "Getting Curves in the Right Places," which concentrates on quadratics. Finally, there are "empirical" games, such as Peg Game and the Tower of Hanoi, both of which yield interesting functions.

Others:

Associated Numbers
Scoreboard Functions
Transformations on a Number Line
Primes and Sieves
Transformations in a Number Plane

5 A Unit Involving "Inference Schemes"

The plan of attack in this area is to put the students into the position of examining the logic which they and others use. Under what conditions is a statement considered "reasonable," and why? By this road, which begins at the end, the unit deals with logical connectives, inference schemes and proof.

6 A Parallel Unit in Math and English

Cryptography. Principles of reasoning that are sometimes applicable to the study of mathematics, language, and literature are introduced to the students via the science of cryptography. The mathematics portion deals with elementary examples of transformation and substitution. These mathematical concepts provide a framework for understanding similar types of manipulation of symbols that are used in codes and ciphers. The English portion deals with word order, letter frequency, and basic language patterns, and moves from solving simple cryptograms to exploring the use of cryptology in stories like Poe's *The Gold Bug.* The unit is flexible enough to allow the two portions to be handled simultaneously, consecutively, or independently.

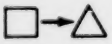
Inside a Math Class

An example of part of a mathematics unit is the work with guessing rules and nomographs. The following discussion indicates briefly how teachers in the Centers have developed the ideas in the unit, and how the students' responses have contributed to this development.

The teacher thinks of a rule (e.g., "double the number and subtract seven"), and the students are set to guessing what the rule is. Although he will not tell the rule, the teacher will give the students, for any number they wish, the result of applying the rule (e.g., the above rule yields negative one when supplied with the number three). Students also make up rules and assume the role of teacher, while the rest of the class guesses their rule. As students ask what result a rule gives for various input numbers, the information gathered can be tabulated on the board in the form of a truth table. Such a table, for another rule, is shown below:

□	△
–3	3
–2	0
–1	–1
0	0
1	3
2	8
3	15
10	120
100	10,200

Here, □ is the number put in, and △ is the result after using the rule.

Schematically, 

or,

using 2,

A table such as this shows that the class has developed some strategy for guessing; they know that certain numbers are most useful to ask, and they have found a fruitful way to organize them.

There are many ways to discover the rule that is being used to generate the table above, and, left to their own devices, most classes come up with a great variety of valid approaches. This is a strength of the topic: it leaves a wide latitude for student participation and contribution. Some students may notice, for instance, that the △ column can be re-expressed as a product:

□	△
–3	3
–2	0
–1	–1
0	0
1	$3 = 1 \cdot 3$
2	$8 = 2 \cdot 4$
3	$15 = 3 \cdot 5$
10	$120 = 10 \cdot 12$
100	$10{,}200 = 100 \cdot 102$

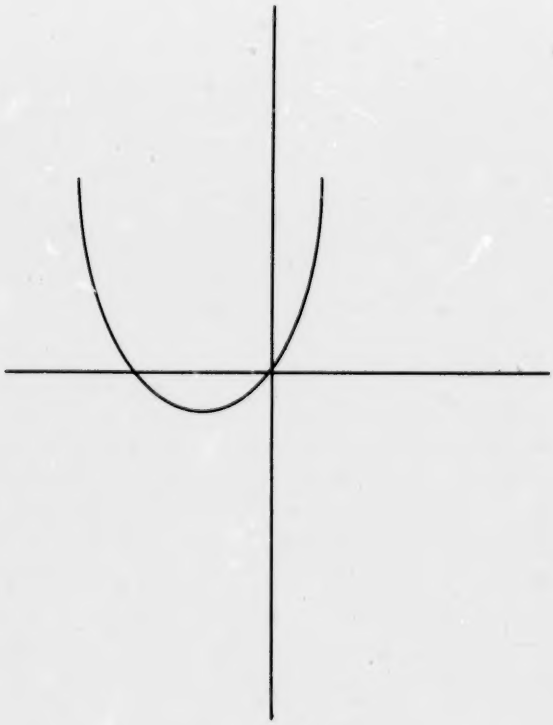
This pattern is most obvious where □ is greater than 0, but checking back shows that it also works for □ equal to zero and for negative values. The rule is □ x (□ + 2) = △.

Other students, however, may choose to look at the difference pattern, generated by finding differences between consecutive numbers in the △ column, and then performing the same operation to find the difference of the differences:

□	△		
–3	3		
–2	0	–3	
–1	–1	–1	2
0	0	1	2
1	3	3	2
2	8	5	2
3	15	7	2
10	120		
100	10,200		

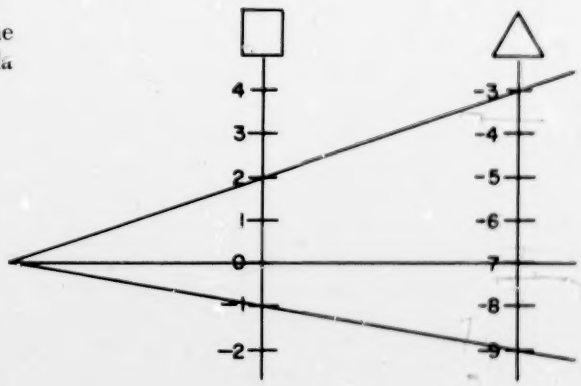
The constant second difference of 2 seems significant, and, after looking at the difference patterns of other known equations, students can discover that this rule has a $\square^2$ term. Further analysis quickly produces $\square^2 + (2 \times \square) = \triangle$ as the rule. Is this a different equation? This is an important question to consider.

Still another student, however, may graph the points given in the table and analyze the parabola that results:



The important point is that the possibilities are numerous, and the mathematical sophistication can be as great or as little as each student is capable of working with.

At the same time, the nomograph can be introduced as an example of a "machine" that works by a rule. The diagram below shows a two-line nomograph that is a "doubling, minus seven" machine.



The two lines drawn from the point on the left through the $\square$ line to the $\triangle$ line illustrate how to use this nomograph to find the value of $\triangle$ when $\square$ is 2, or when $\square$ is negative one. The next question may be to try to invent a tripling nomograph, or a halving nomograph. How does one place the point and two lines so that the machine works by another rule? More difficult still is the problem of inventing a squaring machine, which can lead into exponents and logarithmic scales. Again the field is rich, and the number of possibilities immense.

In both of these topics, Guessing Rules and Nomographs, the sequence of investigations will largely be determined by each class, with its members working independently at times, and as a group at other times.

The emphasis is on the *process* of inquiry more than on the product; on establishing some basis for the thinking, more than on the conclusions. This is why any description such as the preceding can only be an example of how a unit might proceed, and not a prescription for how it should proceed.

Excerpts from a Mathematics Unit

Surface Area This unit can be as long or as short as you like. The first part could be used as an introduction and the last questions as problems to think about or as part of an assignment.

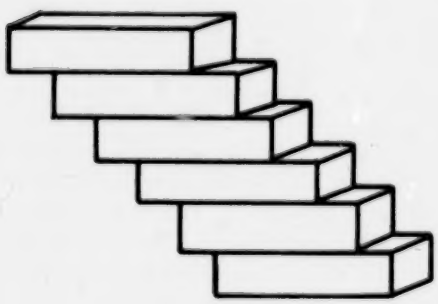
It will be essential that you have some kind of visual aid to be sure the students understand the questions being asked. Balsa or other wood, styrofoam, or any other kind of material could be used for the blocks. Two-inch cubes and rectangular solid blocks two inches by two inches by ten inches seem to be about the right size, large enough for everyone to see, and yet not too large to handle. About ten of each size should be enough. You may want to have enough for each student, in which case a smaller scale could be used.

If each student does not have blocks, then it might be useful to distribute quarter-inch coordinate paper. This would make it easier to sketch diagrams that could be helpful.

One other note, the questions at the beginning may seem trivial for high school students. However, we have found that without these questions many students are perplexed as to what we mean by surface.

Begin by discussing the cube. What kind of figure is it? How many edges? How many corners? If we wanted to cover the surface with postage stamps and each stamp would cover one face, how many stamps would it take? (6) (Throughout this unit the blocks are suspended in space.) . . .

Now build a figure like the one below. Each overlap is one unit. It will be better if you use six or seven blocks.



What is the surface area of this figure? (For six blocks, each five units long; 92 sq. units.) As soon as some students have given answers to the problem with six (or seven) blocks, ask immediately how you would find the surface area if we had 100 or 1000 blocks arranged like this. What are some general methods that would work for any number of *n* blocks, any length? (Note: This might be posed as an assignment for those students who are interested.) . . .

Here is a sampling of other kinds of ideas you and your students might wish to investigate.

(1) Given some number of blocks, all of equal length, how would one arrange them to get the smallest possible surface area? The largest? What would happen if you varied the length of the blocks? Is there some general strategy for arranging any number of blocks of differing lengths to get the minimum surface area?

(2) If you have a block that measures 3 x 5 x 7 and you paint all the outside surfaces and then cut it up into unit cubes, how many cubes will have at least one painted surface? Two painted surfaces? Three? Four?

(3) A 3 x 3 cube is being sawed into 1 x 1 cubes. How many cuts are required if the pieces left by a cut may be repiled before the next cut?

(4) The length of a rectangular block is twice its width, and the height is two more than three times the width. The entire outside surface is painted. What must the dimensions be so that when the block is cut into unit cubes, the number with at least one painted face equals the number with no painted faces?

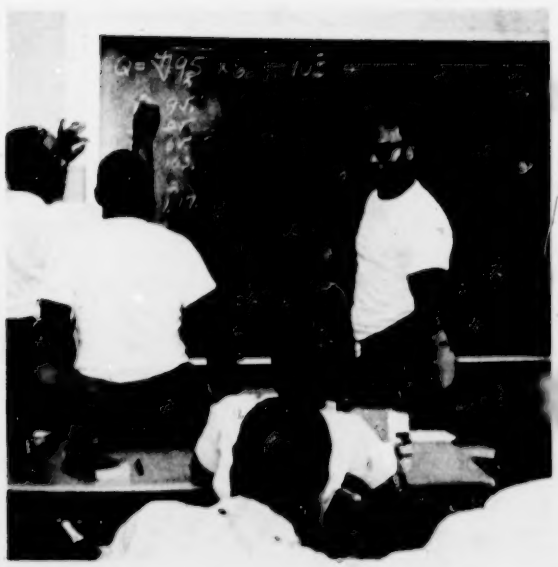
(5) Fill a 10 x 12 rectangle with the fewest possible squares whose sides are integers. (5 x 9 rectangle? 11 x 13?)

(6) What is the ratio of surface area to volume in a block which has a five-unit length?

Construct figures by placing blocks of the same size on top of one another. Investigate the ratio of surface area to volume.

When will the ratio be equal to one?

Using blocks with length five, build several stacks of blocks, each ten blocks high. How many stacks



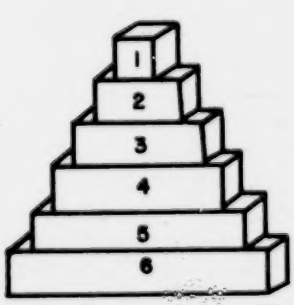
should you move together in order to have a surface to volume ratio equal to one? What happens if you change the height?

How many stacks will it take if each stack is 25 high?

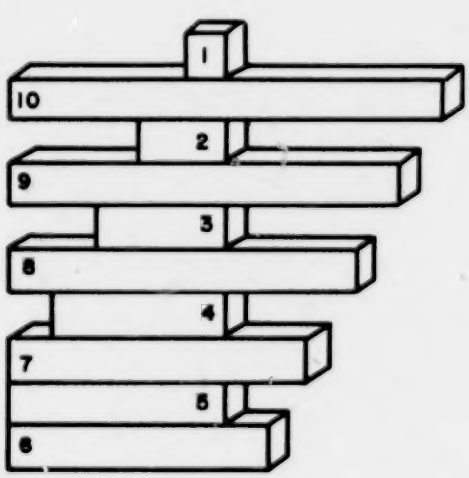
What happens if you choose blocks of lengths other than five?

What happens if you choose different ratios?

(7) What is the surface area of the following figure? Beware the "easy" approach.



(8) Here is another arrangement. What is the surface area here?



What other problems or arrangements can you and your students think of? . . .

The English Program

The English Program for the Pre-College Centers has been designed to revitalize the English curriculum as a relevant frame of reference, which the students can use and profit from, both in their formal education and in their personal development. Since the English class is the logical domain for the development of language skill, the Pre-College English materials seek to provoke in the students an urgency for expression, which will lead them to discover, through their desire to convey clearly their own ideas and opinions, how dependent the effectiveness of their written or spoken communications in *any* area is on their skill in using English. The materials for instruction, therefore, have purposely been made broad enough to cut across artificial barriers in subject matter, fresh enough to avoid the emotional blocks and inhibitions that many students have built up against English courses, and exciting enough to arouse in students a willingness to learn.

The learning aids, which are an integral part of the English Program, have been specially selected to fit the unique character of the materials. An unusual assortment of films, phonograph records, and tape recordings is used, along with such innovations for the English class as paintings, sculpture, fossils, rocks—anything that will serve as additional foundation for the students in making smooth transitions from understanding the tangible to understanding the abstract. In addition, instructional techniques such as role-playing and Chamber Theatre are used to augment opportunities for students to become directly involved in the learning process.

The English materials differ considerably from one another in their immediate objectives and in the literary sources they require. But each is intellectually rigorous in its content, and each permits freedom and flexibility in its use. Furthermore, there is considerable interdependency among them: the increased skill and understanding that the students derive from a particular unit can reinforce their ability to grapple with problems raised in a later unit. The materials also abound with so many potential paths to learning that, although the main road in a given unit leads to a specific aim, the side roads can lead into any of the other units—or into a challenging, unexpected realm for which units have not as yet been developed. When the latter situation occurs, the teacher and students jointly design new units which will take them farther along the path the students themselves have chosen.

In the present stage of development of materials, the English units can be broadly classified into the following six groups. The order in which the groups are listed here, as well as the order of units within each group, is arbitrary. The teacher himself determines which units he will use, and in what order, according to his judgment of the needs and interests of his students. A typical unit within each group has been annotated here in order to illustrate the scope and special features of that group.

1. Units on Letters and Journals of Novelists, Poets, Artists and Scientists

The Letters of Vincent Van Gogh. The letters of Vincent Van Gogh, accompanied by reproductions of his paintings, provide the students with opportunities for gaining insight into the relationship between a man and his creative work, as well as between visual and verbal modes of expression. At the same time, they serve as vehicles for increasing the students' awareness and perception of the hopes and problems that are common to mankind. Through these letters and prints, reflecting Van Gogh's thoughts, emotions, and experiences, the students are brought into contact with a world that differs physically from theirs, but which nonetheless bears social and personal similarities. Van Gogh's loneliness and compassion; his despair at not being understood as a person or recognized as an artist; his relationship with his brother Theo and with his father—these are things which the students can understand immediately, and can often relate to their own situations. The paintings pictorially reveal the attitudes and emotions described in the letters, and thereby also reveal the link between the two means of expression. The film *Van Gogh* further reinforces the students' insight and understanding of this relationship by telling the story of the artist's life entirely through shots of his sketches and paintings, with narration drawn directly from his letters and diaries.

Others:

Picasso

Flannery O'Connor: What She Wrote and Why She Wrote

Charles Darwin

Thomas Wolfe: The Story of a Novel

Henry Moore: Notes on Sculpture

Jung-Freud Disagreement

Storytellers and Their Art

The Writer and His Craft

A Writer Draws a Portrait of Himself: Ralph Ellison and INVISIBLE MAN

A Writer Draws a Portrait of Himself: Katherine Anne Porter and "Flowering Judas"

2. Units on Language and Thinking

An Approach to Style. Since principles of language and thinking—such as style, organization, point-of-view—are abstract and generally difficult for students to understand or sustain interest in, the emphasis in units on such topics is always on starting with meaningful concrete objects that the students can manipulate, or with clearly illustrative literary excerpts that they can associate with related abstractions which they already understand. This movement from the concrete to the abstract, or from the simple to the more complex, is facilitated through the involvement of as many senses as the principle will allow. In this unit on style, three differing paintings on the same subject are exhibited in the classroom so that the students can first approach the concept on a visual level; then three differing versions of the same melody are played, for detection of style in an auditory medium. If necessary, a tactile approach is employed with wood carvings or small sculptures in order to provide a working basis for detecting stylistic differences on the abstract levels of language, in literature.

Others:

Sunrise: Style and Point-of-View

Organization

Symbolism

Taste

Point-of-View

Straight-Seeing, Straight-Thinking, Straight-Writing

Chamber Theatre Technique: An Approach to Point-of-View in Narrative Fiction

3. Units on Literary Genres

An Introduction to Poetry. As in all of the genre units, the abundance of materials from many nations and literary periods makes it possible to present in this unit representative selections that neither repeat the students' previous experiences with poetry nor anticipate those they will have in college. This introduction includes an anthology of "good" and "bad" poetry, an analysis of each selection, and suggestions for what aspects of poetry might be emphasized in this initial unit. The aim is to have the students *enjoy* poetry as they develop taste, discrimination, and meaningful criteria for distinguishing between "good" and "bad" poems. The manner in which the unit is presented allows the students to listen to the distinct "voice" of the genre, as well as to the different rhythms of the poems themselves. Out of their own curiosity, the students begin to probe the meaning, forms, and effectiveness of the selected poems, and through them, of poetry in general. Last year, when E. E. Cummings' poems "in Just—spring" and "Buffalo Bill is Defunct" were read to the students, they were first amused, then intrigued by the strange music of the sounds: the brisk allegro tempo of some phrases followed by the halting largo of others. The students were eager to see how the words were written; to know how one can tell when to rush the words and when almost to stop with them; to understand the intricate relationships between sound and form, and between form and meaning. Their enjoyment of Cummings' poems was the catalyst for their gaining valuable understanding about this and all poetry.

Others:

Negro Poetry

CLAY: Darwinian Concept and Victorian Poetry

Poetry as Experience

On Orwell's THE ROAD TO WIGAN PIER

Haiku

Voices in the Arts

Leroi Jones' THE DUTCHMAN

Camus' CALIGULA

Thurber: Fables and Reading for Pleasure

4. Units on the Immediacy of Language

The Urgency for Expression: The Diary of Anne Frank and the Letters of Sacco and Vanzetti. The impact and emotional power of language are demonstrated in selections from the diary of Anne Frank and the letters of Sacco and Vanzetti. The emphasis in this unit is not on the question of guilt or innocence of the two anarchists, nor on the plight of the young Jewish girl during World War II; rather, it is on man's urgent need to communicate, and the force of expression that often springs from this need. The students study and analyze the diary and the letters in order to discover some of the ways in which these untutored writers were able to achieve immediacy and effectiveness in their use of language.

Others:

Speech Styles: "Square" vs. "Hip"

Truth vs. Fiction

The Living Newspaper

A Word is a Feeling

Mr. Arbuthnot—The Cliché Expert

The Critical Faculty: THAT'S WHERE I'M AT, A Film

THE WORLD'S GREAT SPEECHES

Student Writing: The Effective Use of Descriptive Detail

5. Units on Issues and Ideas

The Hero-in-Jail. The purposes of this unit are to stimulate the students to think, talk, and write, clearly and with understanding, about the issue of civil disobedience, which is a vital part of their world; and to have them consider this issue in both its historical and contemporary contexts. Documented instances of civil disobedience from Socrates, through Thoreau, to Martin Luther King, Jr., are read by the students, and discussions are based on the various views of the individual's relationship to society and the responsibilities that each view of this relationship entails. Supplementary readings enlarge on the theme of civil disobedience, and also provide some interesting contrasts between the hero who is a victim of the jail and the hero who uses jail as a weapon.

Others:

To Kill a Mandarin

Who Am I?: The Search for Identity

The Unreasonable Man

The Press and Local Power

On C. P. Snow's TWO CULTURES

The Press and World Power

THE WINNER, A Film

The Dilemma of Youth

Loneliness

On NIGHT: The Dilemma of Moral Responsibility

6. Parallel Units in English and Mathematics

Alice in Wonderland. An adult reading of *Alice in Wonderland* and *Through the Looking-Glass* gives the students practice in recognizing and interpreting symbols and imaginative meanings suggested by the literal text, with special emphasis on correspondence between Alice's adventures and the theme of "growing up." The students are also encouraged to examine the field of nonsense literature, including the use of game backgrounds. The proposed mathematics portion of this unit will include logic and mathematical principles in game stratagems—particularly chess strategy, which plays such an important part in Lewis Carroll's books. Suggested extensions are afternoon workshops in chess and other games of logic.

Another Parallel Unit: *Cryptography*

Inside an English Class

An English unit consists of the required source materials—the only materials that the students receive; a guide to suggested teaching procedures, including possible writing topics and extensions of the unit; an account of how the unit has proceeded in trial teachings; and a list of recommended supplementary materials, such as related books, films, and records, which the Center provides. What takes place after the teacher and students have their materials for a given unit will vary from class to class.

In the unit, "Student Writing: Effective Use of Descriptive Details," the source materials, "Models for Descriptive Writing," are drawn from authors such as Richard Wright, John Steinbeck, Helen Keller, James Baldwin, Ernest Hemingway; and from such poets as Dylan Thomas, E. E. Cummings, and Theodore Roethke. The students' reading, writing, and discussion are based on the methods various writers have used to achieve vivid imagery for conveying ideas or sensory impressions.

One of the selections, an excerpt from Richard Wright's *Black Boy*, generally rouses considerable student interest. The excerpt consists of a series of descriptive sentences which artfully couple the depicted scene or incident with the sense impression it evoked: "There was the languor I felt when I heard green leaves rustling with a rainlike sound." Students react first to the images Wright conveys. They examine the images to see if these are consistent with their own experiences: Is the early morning dew like a "faint, cool kiss"? Do I feel thirsty when I watch "clear sweet juice trickle from sugar cane being crushed"? Does "hot panic" well in my throat and sweep through by blood when I see "a blue-skinned snake sleeping in the sun"? Some students, having had similar experiences, immediately acknowledge the graphic accuracy of the descriptions; others reflect awhile, compare Wright's descriptions with their own reactions, then demur, "It wasn't quite that way to me; it was more like . . . "

Often students are curious about the style in which the passage is written: a brief opening paragraph, followed by twenty-two sentences, each beginning in a similar way—"there was the delight . . . ," "there was the tantalizing melancholy . . . ," "there was the teasing and impossible desire. . . . " They ask whether the repetitions occur in one place in the book, as they do in their mimeographed copies. Would a writer deliberately be so repetitive? In one class, as everyone considered this question, a student justified the parallelism by calling attention to the rhythmic effect thus achieved, and the class reread the passage to detect this rhythm. As discussion resumed, various members of the class began to point out other discoveries they had made: the descriptions are composed of simple, concrete words; the impressions are based on all five senses; the overall effect is less pleasing without the rhythm of parallel sentences; each sentence includes a sensory impression as well as a detailed description.

After students have examined the passage and discussed their discoveries, they realize that Wright is describing what being alive *felt* like, and they conclude that the validity of his description rests as much on his vivid use of details and sensory perceptions as it does on the commonness of the scene or experience. At this point the students begin to make a conscious effort to examine their own perceptions of experiences and attempt to sharpen their sensory awareness. Using Wright's passage as a model, they describe "what being alive *feels* like" to them:

> *Just what does it feel like to be alive? Well, it feels wondersome and reflective as I watch a zillion blue-bright stars on the window screen during a rain. It feels light and jingling as I wander through the popcorn-neon world of an amusement park at night. It feels mysterious and serene as I watch a purple, then pink, then gold sunrise. It feels warm, bubbling, ticklish and happy as I share the experience of a bunch of "nuts." It feels lively as I hear the laughter of children, but it feels reflective, when I listen to one of the classicists. It feels shocking as my feet pound when I jump up and down in sheer frustration. It feels light and airy as I walk barefoot over a lush carpet. It feels monotonous, and yet consoling, as my feet fall in an uncertain rhythm over an endless stretch of pavement. It feels terrifying as I feel a sharp, breathtaking pain in my side that says, "Slow down and live." It feels hopeful as I meet a walking-bush type dog that's even odder than I am.*

To be alive is to disburden myself of the world during the split second I am floating free, defying the laws of gravity, in mid-air during a two-meter dive.

There was a refreshing tickle of wet grass on my ankles. The early morning breeze was blowing damply, clearing my foggy mind.

To be alive to me feels a mess. You are like yeast, a ferment, a thing that moves and may move for a minute, an hour, a year, or a hundred years. The big eat the little so they can continue to move, the strong eat the most and move the longest. To be alive is piggishness. You live to eat so you may continue to live. Yes, we live for our bellies' sake.

Being alive is feeling superior to someone who is inferior to me.

To me wonderful is entering into a filling station, smelling the extraordinary aroma of gasoline, which deadens the senses of reality, and releases an urge to drink all the gasoline in the world.

In another class, using the same unit with the same models, students express particular interest in the use of metaphor, such as the one from T. S. Eliot's "The Love Song of J. Alfred Prufrock": "I should have been a pair of ragged claws/ Scuttling across the floors of silent seas." In one class, for example, after discussing this metaphor the teacher asked if anybody would like to imitate this form, using an image more relevant to his own experience. One student volunteered and wrote on the board: "I should have been a tree/ Branching out the way nature wanted me to." The class became involved in a fervent discussion of the analogy between human and tree, which they gradually began to examine in terms rather too literal. The teacher brought up another analogy in order to help them resolve the difficulty: "Suppose I said someone were a rock of Gibraltar, what would I mean?" Everyone quickly recognized the metaphor as signifying strength. One student pointed out that the implied comparison did not mean that the person was literally a rock, nor that he wished to be one. Gradually others in the class began to realize that comparison in a metaphor does not require a total transference of roles, and the class returned to the student's analogy of the tree with a greater understanding of the way in which metaphor enriches an abstract idea.

Later in the same discussion, another student noted a difference between the anology using the rock of Gibraltar and that using the tree: "We all agreed at once what 'rock of Gibraltar' meant—that wouldn't be very good in a poem; but look how we argued about the meaning of the 'tree-idea'—that would make a poem more suggestive." Thus, through this student's observation the class was led to identify the difference between metaphor as cliché and the complex, because less obvious, poetic metaphor.

In a class such as this, as well as in other classes using the unit on Student Writing, discussions also touch upon the use of simple, descriptive details, the images conveyed, the rhythm of the passage, and the overall effect and how it was achieved. In addition, effective use of the students' own awareness not only of what they see, but what they hear, taste, smell, and feel, becomes a major concern. Then they are ready to construct their own images, using, in this case, Eliot's metaphor as a model:

I should have been a brook, where people could come and look.

I should have been a rattlesnake, moving in the lowest form.

I wish I were a denizen of the sea, hiding my loneliness in the deep.

I should have been a cloud, and drifted as part of the heavens.

I should have been a flower, withered from lack of sun.

I should have been the ocean, to spread out far beyond what the eyes can see, to roar fiercely in the wind and upon the shores.

I should have been a dinosaur, effaced by the footsteps of time.

I should have been a windowpane, shattered by a ball.

I should have been a tree, branching out the way nature wanted me to.

Though metaphor was used as a springboard to student writing in one class, and sensory impressions were used in another, both led the students through similar stages of observations of descriptive language. In each the students worked with concrete details rather than with vague abstractions; took the passages apart and put them together again; explored the total effect as well as the means for achieving it; and eventually, after a kind of five-finger exercise, arrived at the discovery that effective writing depends upon actual, observed details and vivid imagery, concrete language that is fresh and alive, rather than upon impressive-sounding but vague abstractions. In other classes the springboards may be found in still other models, but the conclusions nevertheless will be similar. This is the strength of the materials: there is sufficient latitude for each class to follow the direction it finds most interesting, yet each class arrives at comparable insights into the relationship of carefully observed details to vivid descriptive writing.

Excerpts from an English Unit

An Approach to Style

Materials:

1. RECORDINGS: 3 differing jazz styles—Dixieland, Swing, Modern Jazz—of the same composition. (Three versions of "Sweet Sue" are suggested and are available at the Centers, but any selection may be used.)

2. PRINTS: 3 differing painting styles of same composition
(Available at the Centers)—
Expressionism—"The Yellow Violin" by Dufy;
Realism—"The Old Violin" by Harnett;
Abstraction—"Musical Forms" by Braque.

3. EXCERPTS (APPENDIX A), FROM *A Treasury of Great American Speeches,* CHARLES HURD:
Jane Addams' Eulogy of George Washington;
Robert G. Ingersoll's Eulogy of James G. Blaine;
Carl Sandburg's Eulogy of Abraham Lincoln.

4. MIMEOGRAPHED EXERCISES ON STYLE:
The Faces of English—Appendix B
Paul Sails to Italy—Appendix C

Notes to the Teacher Although the primary objective of this unit is to have the students learn experimentally some basic concepts of style and, consequently, arrive at some definition of it, related questions are bound to be introduced. Some in the class may wonder about the influence of style on feeling or mood. For example, one student observes that a work seems gay to him, while another insists it seems sombre: why should the same work produce opposite effects in two individuals? Is the reason for this to be found in the individual or in the work? What is the relationship between the audience and the work, in this case, its style? Of course, these are not questions that the students may be able to answer for themselves, but the answers—if there are any—are not important at this time. What is important is that the students consider these questions when they come up, because their process of analyzing the validity of certain responses (e.g., "The Dixieland version seems gay because it reminds me of . . ."), their efforts at distinguishing between the act and the reaction, the objective work and the subjective evaluation, will help them in understanding the significance of style.

In some classes, as the students begin to realize that what has happened to the tune "Sweet Sue" in the three musical versions is similar to what has happened to the violin in the three paintings, they may be tempted to make unwarranted parallels between the musical styles and the painting styles, merely because there are three examples of each. When this occurred during a demonstration class, the teacher forestalled erroneous conclusions by introducing additional examples which, while serving to further clarify style, obviously discouraged attempts at making the music and paintings comparable. Other teachers, however, have pointed out that confusion is also satisfactorily averted by moving to the three prose selections, which certainly will not fit whatever forced categories some students may have established for the music and paintings.

Suggested Procedure

A. Musical Styles: Since music is a more familiar medium, the students will probably move more easily toward the concept of style if you begin with the three differing musical styles. Without introduction or explanation, play for the students the tape recordings of the three jazz versions of "Sweet Sue." After each version, allow them to discuss fully what they have heard, making comparisons of the versions as they are played. We have found that it is not necessary to stress technical terms in the discussion; the important thing is for the students to note the differences among these various styles in jazz and to describe these differences in their own words. Some of their comments may seem inconsequential at the moment, but later in the discussion they may play a significant role.

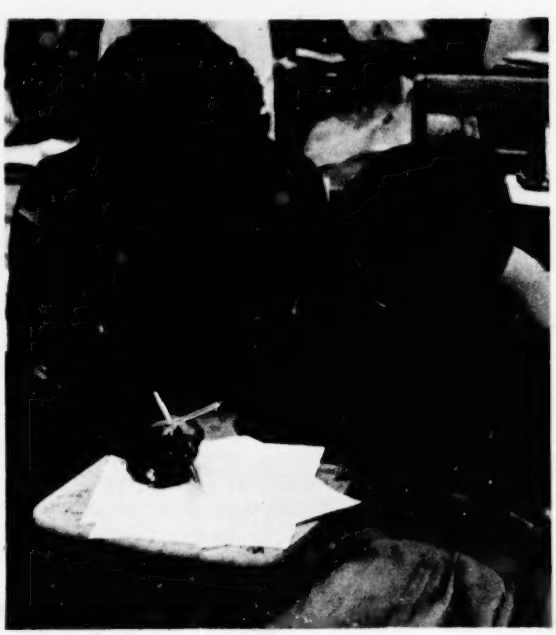
If you play the Dixieland version first, as we usually do, the students may not catch the tune, and may think it is "confused," "not definite." As you move into the other versions, however, they should be able to detect that each is handled differently even if the melody still eludes them. At some point, someone may notice that all three are versions of the same song. Even so, the tape recordings should be played straight through again so that the other students may discover this similarity. It might help

the class if the student who has caught the tune can be encouraged to sing, hum, or whistle it. With the melody in mind, all of the students should find it easily in all three versions. Occasionally, however, none of the students may recognize the song or even realize that the same tune is being played. In some classes, we have found that this does not present a problem, as the students nevertheless notice that the ways of playing are different. When this failure to recognize the song or similarity of tune has seemed to hinder the class, we called the tune to their attention in the more melodious Swing version, and had them look for it in the others.

Once the students have discovered the similarity of tune, they should be allowed to explore more deeply their reactions to the versions and what they have observed about each. It will help them to reach some conclusions about the jazz styles if you list their comments on the board under the appropriate version (e.g., I—"1920 music" "confused" "not definite"; II—"1930's" "even-tempo" "arranged" "logical"; III—"1950's" "meditative" "abstract"). Most likely, they will be able to conclude that the same melody is being played in different ways—each way special and unique. *If necessary,* help them toward a conclusion with hints, suggestions, and questions. Probably, the word *style* will come up eventually as a sort of summarizing noun for the diverse comments they have made about era, instruments, rhythm, tempo, total effect. When they do reach some tentative idea of style in this musical context—even if the term itself is never used—they are ready to move on.

B. Painting Styles: With the students' comments about the jazz versions still on the board, place the three paintings side by side for the class to study. All of the students should immediately recognize the violin in the three paintings, and as they discuss their reactions to the paintings, references to their previous reactions to the jazz versions should come easily. Some of the students will have little difficulty in seeing the relationship between their conclusions about the jazz pieces and the three paintings of the violin. Their comments should help the others to see that each painting uses the violin in a different way just as each jazz selection used "Sweet Sue" differently. Sometimes, however, you may find that some students will react to the color stimuli in the paintings without sufficiently noticing the similarity of subject. In such cases, we have successfully overcome that problem by having the students give a literal description of the paintings.

As class discussion continues, some conclusions will be reached about the relationship between what was done in music and in painting. By then the term *style* will probably be used frequently, with some insight, hopefully, into its meaning and complexity. Once the students reveal such insight, with or without using the term *style,* they are ready to consider style in language. . . .



The Structure of Learning

Through innovations—not so much in what *is done as in* how *it is done—learning becomes an exciting and pleasurable challenge to the students. . . .*

Our central focus in the Pre-College Program is on providing each student with maximum opportunity for becoming personally involved in learning, and for developing and following his own path. To attain these ends, we have divested our Program of some traditional rules and practices and have instituted in their stead a new structure of learning. This new structure is not limited entirely to experiences in the classroom. New patterns of intellectual discourse and interaction among teachers, students, and visitors to the Centers, in the classroom and outside, create a broad social context for reinforcing the students' emerging positive attitudes toward learning.

New Rules for an Old Game In the Center classes, we have eliminated examinations, grades, syllabi, and detailed lesson plans, primarily because such devices tend to foster circumscribed learning situations. Instead, we wish to provide the kinds of situations in which the teacher and the students are free to move in whatever paths the students' learning patterns dictate, and in which each student's process of thinking or problem-solving is of far greater importance than the specific conclusions or answers he reaches. We have chosen, therefore, as our basic method of teaching, a non-directive, inductive approach which consists of Socratic dialogue and open discussion, and which places emphasis on student participation and independent discovery, and on the type of exploration and inventiveness that Jerome Bruner calls "left-handed" activities (in *On Knowing: Essays for the Left Hand*). The student is encouraged to take the initiative in his classwork, to learn how to compete with himself, and to find both his own questions and his own answers. The climate thus created is conducive to intellectual awakening for the students and, at the same time, to professional stimulation for the teacher.

The Teacher and the Program Any changes in educational philosophy or practices must be reflected in the attitudes and methods of the teacher. The kind of teacher that we recruit, therefore, is as important for promoting the desired learning situations as are the principles that we follow. For this reason, the teacher in the Program is selected not only for his academic background, but for his warmth and sensitivity to students' needs, his creativity and special talents that can be brought to bear on the materials, and his willingness and flexibility in adjusting to new conditions in the classroom.

The Program relies heavily on the personal and professional qualities that the teacher brings to the classroom. The freedom granted him in his classes entails great responsibilities. Since he cannot "prepare" in detail for any given class beforehand, he has to be perpetually alert—to work on the spot with student responses that simply could not have been anticipated. He has to be able to refrain from assuming an intellectually authoritative role, and, instead, to strike a suitable balance between leading and following class discussions: in some situations he has to be an energetic source of provocative, probing questions; in others, he has to step back, restrain himself, and let the students question and discuss freely. It is also his task to encourage the students to rely mainly upon their own discoveries; to let them assume as much responsibility for their own education as they can; and to help them develop a firmly-based intellectual self-confidence.

In handling the new materials in the Center classes, the teacher accepts a unique responsibility. He keeps a diary on the effectiveness of the various units, notes where improvements are needed, and records any particularly successful development that has taken place in his class, either with the suggested materials or with his own. By so doing, he performs an indispensable role in helping to revise materials or in bringing new ones into being from his direct and continuing experiences in the classroom. As a result, the Program profits immensely from his contributions.

The teacher, in turn, profits from being a part of the Program, since he is free to develop and refine some of his own ideas that are in keeping with its basic philosophy. He also takes back to his high school or college classes any new attitudes and methods, fresh convictions, and experimental materials that he has developed and tested while teaching at the Pre-College Center. Through the reciprocal benefits that the teacher and the Pro-

gram receive, both grow more effective, and the results of this growth are felt in the double impact of innovation both on the students and the teacher, and through them, on their subsequent educational environments.

Students Helping Students The social environment we envisioned for the Program's learning experiences required more than students and teachers; a liaison was needed to bridge the gap of age and experience that separates a teacher, no matter how warm and sympathetic, from the students. Therefore, a corps of articulate and personable undergraduate and graduate students was recruited from the colleges in the local communities, to serve as program assistants. We did not intend these older students to be tutors. They were, rather, to act as models and guides, leading the younger students through the necessary adjustments to their new experiences, encouraging them to air their problems and to learn how to deal constructively with them.

The program assistants work closely with the teachers and counselors in planning vocational and educational guidance programs for the students. They also work with the students in organizing field trips to various government and industrial establishments; workshops in folk music, dancing, arts and crafts, debating; and cultural activities, such as attending concerts and plays, and visiting art museums.

Since each program assistant works with no more than ten students, he is able to give them personal attention and concentrate on the productive qualities of the interpersonal encounter. The genuine interest and warm friendship that the program assistants offer the young students can ease the social and intellectual transition that the students face in moving from their often bleak environments into the more promising world of college.

Afternoon Program The unique learning situations that we offer the Pre-College students in their morning English and math classes will only be sufficient to our purposes if the students also have opportunities to apply and extend their new knowledge, to pursue in greater depth the problems and ideas raised in class, and to discover and develop

Facsimile of a report from a Center teacher:

POW!! It happened!! I felt a bit like Handel when he said, "I could see the gates of Heaven open..."

The unit was called Symmetry; I had used it 3 times before. Things started in the usual manner: "Let's imagine we are in the linoleum tile business..." About half way through the period, a student was at the board discussing his ideas about the symmetry of a figure -- when a spark, a point, an idea, some factor, set off a chain reaction which in 30 seconds captured the attention, the imagination, the thought processes of every student in the class, and 30 seconds later, every member of the group -- except four -- were at the board, seeking to clarify terms, expressing their views, proving the logic of their reasoning. The dispute raged the remainder of the period. Not even the appearance of the "Big Brown Envelope" quelled the intellectual riot! Involvement!! Now I know what it means, how it looks, what it feels like.

Why today? What was different? Did I, as a teacher, do something? How can I cause this to happen next week?

Yesterday was a holiday; the kids were fresh, relaxed. Is this the answer? We've been together 4 months now; they know it's all right to talk out, to go to the board and prove their point, to disagree. As a "true believer" in the inductive method of teaching, I hope the latter possibility is most valid.

Today, I saw for a few moments what a class, our Program, can be. I'll never be the same again.

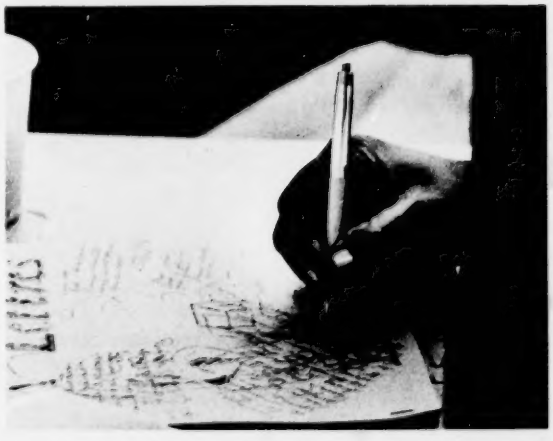
their own talents, interests, and abilities. We attempt, therefore, to make such opportunities available to them in the variety of educational, cultural, and recreational activities that comprise the afternoon program.

Some of these activities are arranged in advance by special consultants, and are offered at all of the Centers. For the film workshop, for example, a group of specialists in film education prepared the guidelines for a program in which the students themselves undertake all the steps leading to the creation of a finished film: choosing an original story line, acting, directing, shooting, and editing. The students receive advice and guidance from a specialist in residence at each Center, but they are given complete freedom to plan and execute their film. This freedom of choice stimulated a range of student effort last year. Some students attempted documentary films, drawing the subjects from their own experiences; others explored more experimental techniques; and one group devoted their attention to making an animated cartoon.

Other afternoon workshops grow out of the particular interests and talents of students at a particular Center. Music, art, drama, creative writing workshops were arranged at each Center at the request of the students. An electronics workshop was set up at one Center in response to the students' interest in a math unit on "Switches and Batteries"; at another, a workshop in contemporary religions was formed as a result of a provocative English class discussion on Dostoevsky's *Crime and Punishment* and Shirley Jackson's "The Lottery."

In addition, each Center offers its own unique activities, made possible by its specific locale. The terrain at one place provided the requisites for forming a mountain exploration club. In other places, the cooperation of business and industries allowed the students to form computer programming workshops. At all Centers, the staff and students plan together to exploit to the fullest whatever resources their local communities offer.

By taking advantage not only of the community resources, but also of the talents and skills available among the staff, students, and visitors, we are able to offer the students at each Center a wide range of meaningful afternoon and evening activities.

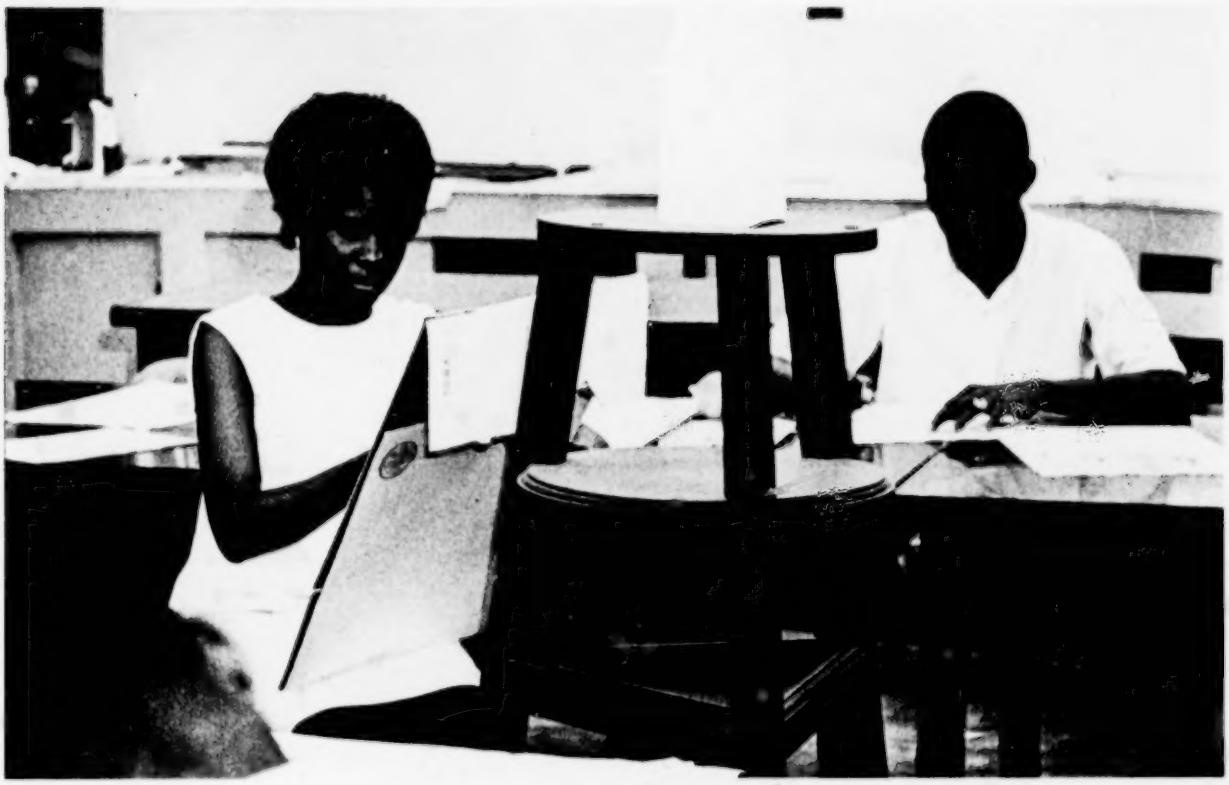


A Sampling of Student Activities

Students at each Center are offered a diversity of afternoon workshops and special classes from which to choose.

Some go "on location" with their advisers . . . to direct and shoot their first film. . . .

. . . or to enter the exciting new world of cave exploring.



Others prefer a workshop in drawing . . .

. . . or a swimming class.

Sometimes students initiate their own workshops and activities

Young poets start a workshop in free verse and haiku . . .

ON WAR

Wash your hands, War.
They're dirty. You torment, you bleed, you reek of
The pains and cries of a million forgotten men.
You dance and kick and throw your head with glee. Voom!
You're not so grand—no, not at all.

Wash your hands, War.
Don't they bother you? Can you bear to look and touch
Them day after day? I could not, I would not—not if I
Were you.

I'm told that you do some good for the world. They say
You make men of mice; they say you strengthen, unite,
Arouse the cause for protection of a common right.
Maybe you do.
But you take young husbands from their wives and babes
Never to return again.
You summon the best we have to offer, promising perhaps
To soon return.
They seldom do.
You caused to be destroyed arts and wonders of centuries'
Sweat. Long, tortuous hours of creation and agony mean
Nothing to you. You tear them to whorled shreds within
The wink of an eye.

Have you a mirror, War?
Do you look into it each day? See you the once starry-
Eyed maiden whose lover you took away? See you the graying
Old mother who wrings her hands, rocks, rocks, and prays
That she may see her son in her old age? See you the
Dying babe whose eyes roll around in their sockets and
Whose tiny stomach contracts and rumbles with pangs of
Hunger? His wretched mother lies beside him. Her
Milkless breasts heave with discontent; she dies, her
Child dies. War, see you all of this?

Wash your hands, War.
Oh, how great the effort to get them clean.
Wash for eternity. Wash with all the soaps and waters
Of ages to come! You fail!
You'll never get them clean, War—no, not now, or ever
Or even after that. You'll never—your effort's
Wasted, War.

—Crystal Kilgore, Summer 1965

THE SEA

Endless waters
Infinite; ever changing
Roaming forever in your generous confines.

Stretching, as a restless child does after sleep
Aware of your potential power;
Ancient mystery.

Turbulent waters
Raging like a madman in his cell
Raising mighty arms in restless defiance.

Curling against rocks
Spitting profanely at the sky
Beating on the shores in time-old rhythm.

Gentle waters
That shyly approach the brown beach
As a young, timid animal
Approaches the outstretched hand of a stranger
Only to quickly retreat.
—Dorothy Roper, Summer 1965

Through the high-thick grass
That nature has provided
The meadowlark scampers.
—Timothy Elliott, Summer 1965

Walking along the lake
Angry at my sister
I felt a warm breeze.
—Philip Sears, Summer 1965

While an English class plans a field trip

"Ever since I started school, someone has been telling me what's good for me to read. I don't think we'll ever get around to what I want to read."

This comment by a student led to the planning of a special afternoon activity: a trip to a local bookstore. As preparation for the trip, an English class period was devoted to the discussion of possible selections, and it was decided that each student would pick out the one book he particularly wanted to read. The teacher made arrangements with the owner of the bookstore to have the bill for the books sent to the Center.
Afterwards, one student chose to write about her trip:

"This day was somewhat different from other summer school days. . . On this day, my English class was going to the bookstore. We each received the English 'Models for Descriptive Writing,' and we discussed brief excerpts in class.

"In the discussion, everyone talked and participated as if they each had their own favorite author. Each of us wanted everyone to know his or her author's name. It was felt by all that we could go and make a good selection without much, or should I say any, difficulties.
"After entering the bookstore, some of us felt as if we were in the largest bakery in the world, where the world's finest goodies would be gotten; but we would only have one choice. It was humorous to me because everyone got a book whose author was different from their original choice."

The trip was the exciting topic in many of the students' remarks:

"This is the first time I have ever had an opportunity to go to a bookstore and select a book for my very own. I was so excited I had trouble making up my mind."

"You didn't feel pushed. You could relax, smile, and enjoy reading."
"I was glad we didn't have to write a written report on it. I would have selected a book of about 60 pages if we did."

"I enjoyed the way we went. We were on our own. We had to select something meaningful to us. I felt like an adult."

Teachers also arrange special activities for the students

"Man, nobody has to translate this book [by James Baldwin] for me. I know what that cat's saying. That's just like my house on a holiday: everybody sitting around, talking, doing nothing."

The owner of the bookstore also shared their enthusiasm:

'You know, I didn't realize it before, but these kids are selecting books like all the adults that come in here. I don't know of any better way to become involved with a book than through self-selection."

Here are the titles of some of the books the students chose:

THE GREAT GATSBY
THE SUN ALSO RISES
A RAISIN IN THE SUN
THE BROTHERS KARAMAZOV
THE FIRE NEXT TIME
THE UGLY AMERICAN
JOY IN THE MORNING
TO KILL A MOCKINGBIRD
RAISE HIGH THE ROOFBEAMS, CARPENTERS

On February 5, fifteen of us spent an afternoon in the shop of Mr. Bob Westervelt, well-known Atlanta-area sculptor. Mr. Westervelt, who is both an exhibiting artist and a member of the art faculty of Agnes Scott College, seemed to fall intuitively into the ASI spirit: after a short demonstration, during which he "threw" a large bowl and a vase on his potter's wheel, he invited the daring members of the group to try their hand at it. Within minutes everyone was elbow-deep in wet clay, and six potter's wheels were in motion. Mr. Westervelt's cautionary advice that we not make anything so good that we would hate to part with it was probably unnecessary, given the results of our "throwing", although some latent talent shone through in places.

Both Mr. Westervelt and his wife, Pat, worked with us, suggesting ways by which we could improve our work. We learned a good bit about the use of the potter's wheel, and discovered the difficulties inherent in the whole process.

Following an hour-and-a-half spent working in the shop, we were invited to examine the "functional" pottery work in the Westervelt home. These pieces included lamps, plates and bowls, statuary, and even framed ceramic-type wall hangings. We found the Westervelts to be both gracious hosts and excellent instructors.

The high point of the visit was, of course, the opportunity to actually work in the artist's medium.

An Informal Evaluation

Former Pre-College Students reflect on the Program . . .

At an orientation meeting in February 1966, three freshmen from Howard University and one from Bethune-Cookman College—all former students of the Howard Pre-College Center—discussed their impressions of the Program:*

Iris: Referring to the question about the Pre-College Center and what we got out of it, it was sort of like a revelation. I mean, you know for once in your life that there is something that you can think about on your own, and you know that you are capable of doing this. So if you have to go back to the same old routine, at least you'll know that the other exists. And I think that is one of the most important things, whether you get an instructor [in college] that lets you say more or less what you want to or not, you know that *that* was there, and that for a time you had it. And you know that it exists.

Earl: . . . Being in the Pre-College Center, I developed new interests. Before, I *thought* I was interested in art and music and literature and things of this nature. But being in the Pre-College Center helped to show me how ignorant I was of what art really was, and what *was* in English,—[things] that I was overlooking. Before, I would just go to an art gallery and look at a painting by Van Gogh, and I would probably even say, "That's beautiful," or something like that. . . . But the teacher [in the Center] brought out how we're supposed to look for detail, and how you're supposed to look for the painter's style, and also look for unusual types of expression and movement in writing, and things of that nature—also in music—and in drama. I enjoyed looking for details, greatly, because we tore apart different excerpts from writers, and it helped me to see through a person's written piece of work—it helped me to see the thing as more than just a passage of words; but to see a main idea, and a series of details, integrating or building up this main idea, adding to it, forming it. And it has helped me to organize my thinking, and channel my way of thinking—it has helped me to think intelligently.

Charles: You go through twelve years of high school, and teachers tell you, "Write a paper on so-and-so." It's boring. But in this Program, the teachers told you to write on what you thought best, or what you were best fitted to write on. I never thought that I could write a paper as good as some of these—well, *I* thought they were good, anyway. And [my teacher] helped me a lot by not grading my papers; she just circled my errors, and every evening I'd go and pick up a dictionary, and straighten them out. So it made me feel good. And the math—I'm never very good in math and I always run away from it. But the math was enjoyable, because every day the teacher would say, "Well, wouldn't you like to work on this today?" or "Does this problem work for you?" No, the problem didn't work for *me*, but every evening I'd try the problem out a little more, and it would help. So the Program helped me in a lot of ways.

Earl: . . . After I completed the course, I thought to myself that the theme of the course—if I were to write on it—I would call it a thinking course. To me it came as though at the time I was really thinking, and it—not directly "taught" you—but it gave you a perpetual method of thinking. I think a person would profit from taking this course, more so than taking a course in, say, history, because he may forget a lot of dates and things that he learns in history, but you don't forget how to think in a certain pattern. It's something that just grows on you, and that's what happened to me at the Pre-College Center. . . . In college, when you come up against a problem, it helps you not to just try it a couple of ways and then give up, but it helps me to keep thinking of different channels, or ways to solve the problem.

* Transcribed from a tape recording.

A Systematic Evaluation

A team of behavioral scientists outlines plans for an appraisal of the Pre-College Program . . .

Although the gathering of impressions from teachers, program assistants, students, and visitors at the Centers on the strengths and weaknesses of the Program is of considerable value in making an informal assessment of its impact, this is by no means a sufficient basis for judging the success and effectiveness of the Pre-College Program. Objective data, systematically collected and competently analyzed, must be the primary foundation of a valid appraisal.

A group of educators has been serving as an advisory committee* to determine a just system of evaluation, to select two behavioral scientists to establish and implement the research program, and to provide counsel for these researchers as needed. These two staff members are now working closely with the Center personnel in collecting the pertinent data and directing the follow-up studies that are necessary for the evaluation.

The research staff, with the counsel of the advisory committee, has decided upon two basic aims for the evaluation study:

1. to identify the special features of the Program which should be continued, and those which require modification;

2. to determine whether the Program as a whole has a long-term effect upon the students' education and vocational choices and achievements.

To attain the first goal of the study, the research staff proposes:

a. to conduct extensive interviews with Pre-College Program students in order to determine which aspects of the experience they perceive to be most helpful;

b. to compare and contrast student reactions to the Program at each of the six Centers.

To meet the second objective of the research plan, a four-year follow-up study is projected. The researchers intend:

c. to select a matched group of students who are similar in educational attainments and socio-economic status, but who did not attend one of the Pre-College Centers;

d. to compare the Pre-College students and the controls on the objective measures of academic progress, such as percentages entering and graduating from college, and the level of performance while in college;

e. to compare attitudinal changes of the Pre-College students with the control students, by testing each group before, immediately after, and a number of years after the Pre-College experience. Particular emphasis will be placed on the attitudes of the students toward themselves, their futures, and the value they assign to education.

From the results of the comparisons of both objective and attitudinal data from the Center participants and the matched non-participants, conclusions will be reached concerning the efficacy of the Pre-College experience in promoting the growth of a more positive self-image, raising the student's level of aspiration, and motivating him to work to the best of his ability in obtaining a college education.

*Members of the Research Advisory Committee are listed on page 40.

Sample Data on Pre-College Students

Sample

FAMILY INCOME STATISTICS OF PARTICIPANTS IN ONE PRE-COLLEGE CENTER

(Dillard Pre-College Program, Summer 1965)

NUMBER OF CHILDREN IN FAMILY	TOTAL IN GROUP	AVERAGE INCOME PER FAMILY	PERCENT OF TOTAL PARTICIPANTS
1	23	$2,788.30	13.7%
2	26	$3,148.58	15.4%
3	30	$3,594.95	17.9%
4	30	$3,857.17	17.9%
5	21	$4,238.71	12.5%
6	7	$4,688.00	4.2%
7	14	$3,432.43	8.3%
8	7	$4,709.57	4.2%
9	5	$4,861.40	3.0%
10	2	$4,075.00	1.2%
11	2	$3,874.00	1.2%
12	1	$1,280.00	.5%
1–12	168		100.0%

CURRENT COLLEGE ENROLLMENT OF SUMMER 1965 PRE-COLLEGE ALUMNI

ENROLLMENT	DILLARD	FISK	HOWARD	MOREHOUSE	TEXAS SOUTHERN	WEBSTER	ALL CENTERS
Local Colleges	114	114	104	101	116	58	607
Out-of-City Colleges	29	10	26	21	44	24	154
Total Enrollment All Colleges	143 (85%)	124 (78%)	130 (79%)	122 (71%)	160 (83%)	82* (88%)	761 (80%)
Not Enrolled	25	23	20	46	11	9	134
No Information	0	11	15	4	21	2	53
Total Number of Students	168	158	165	172	192	93*	948

*This figure excludes the 50 juniors in the Webster Pre-College Program, Spring-Summer, 1965

Persons Associated with the Program for Pre-College Centers

Administration
Herman Branson, *Director*
Emily Morrison, *Associate Director*
Judith Andrews, *Program Manager*
Carolyn Fitchett, *Program Coordinator*
Lometor Pinnick, *Administrative Secretary*
Elizabeth Daniels, *Secretary-typist*

Curriculum Resources Group
ENGLISH
Arthur Davis and Lawrence Langer, *Editors*
Joan Murrell, *Resident Editor*
Carolyn Feshbach, *Editorial Assistant*

MATHEMATICS
W. L. Barclay and W. J. Nicholson, *Editors*
Donna Doyle, *Resident Editor*
Forrest Priddy, *Editorial Assistant*

Research and Evaluation Group
Paul Daniel Shea, *Director*
Victoria Steinitz, *Research Associate*
Naomi Cherkofsky, *Secretary*

Consultants on Preparation of Materials
(Wheelock College, Summer 1965)
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North Bennington, Vermont

John Alexander, *Department of Mathematics*
Boston State College

Lettie J. Austin, *Department of English*
Howard University

William L. Barclay, III
Commonwealth School and Urban School
Boston, Massachusetts

Alan Blackmer, *Dean of Faculty, Phillips Academy*
Andover, Massachusetts

Herman Branson, *Head, Department of Physics*
Howard University

Edward Carroll, *Department of Mathematics*
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Robert Christin, *Department of English*
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Carolyn Fitchett
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Newcomb Greenleaf, *Department of Mathematics*
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Commonwealth School and Urban School
Boston, Massachusetts

Phyllis Klein
University of Illinois Arithmetic Project
Educational Services Incorporated

Lawrence Langer, *Department of English*
Simmons College

Philip Morrison, *Department of Physics*
Massachusetts Institute of Technology

Joan Murrell
Educational Services Incorporated

William J. Nicholson
IBM Watson Laboratories
New York City

Douglas O'Connor, *Writer*
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Lee Osburn
University of Illinois Arithmetic Project
Educational Services Incorporated

Alfred G. Redfield
IBM Watson Laboratories
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Morgan State College

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Central State College, Oklahoma

Marcia Watson, *Department of English*
Volusia County Junior College, Florida

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Philip Morrison, *Department of Physics*
Massachusetts Institute of Technology

Jerrold R. Zacharias, *Department of Physics*
Massachusetts Institute of Technology

Ad Hoc Committee of the American Council on Education

(In 1964, when Program was instituted)
Herman R. Branson
Howard University
Committee Secretary

Roger W. Heyns, *Vice-President for Academic Affairs (in 1964)*
University of Michigan

Martin D. Jenkins, *President*
Morgan State College

Samuel M. Nabrit, *President*
Texas Southern University

Samuel Proctor, *President (in 1964)*
North Carolina A. & T. College

Mina Rees, *Dean of Graduate Studies*
City University of New York
Committee Chairman

John C. Warner, *President*
Carnegie Institute of Technology

Stephen Wright, *President*
Fisk University

Jerrold R. Zacharias
Massachusetts Institute of Technology

To Gladly Learn

The Program for Pre-College Centers

Supported by

The Carnegie Corporation of New York
and the Office of Economic Opportunity

Program Director:
Dr. Herman R. Branson
Howard University
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Director: Miss Adrienne C. Tervalon

FISK UNIVERSITY
Fisk Pre-College Center
Nashville, Tennessee
Director: Dr. Stanley I. Alprin

HOWARD UNIVERSITY
Howard Pre-College Center
Washington, D.C.
Director: Mr. Conrad D. Snowden

MOREHOUSE COLLEGE
Morehouse Pre-College Center
Atlanta, Georgia
Director: Dr. Arthur C. Banks, Jr.

TEXAS SOUTHERN UNIVERSITY
Texas Southern Pre-College Center
Houston, Texas
Director: Mr. William A. Lawson

WEBSTER COLLEGE
Webster Pre-College Center
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